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due to the Purkinje effect. It is easy enough to reduce the visible hydrogen spectrum, derived from spectrum tubes, to the single line $H\beta$, by merely diminishing its brightness; but to my eye, at least, $H\gamma$ always disappears before $H\alpha$. In the nebulæ, on the other hand, $H\gamma$ is seen without difficulty, while $H\alpha$ is generally invisible. In some stars we find hydrogen exhibiting certain spectral peculiarities which have not yet been produced artificially, and certainly there is nothing absurd in the supposition that hydrogen in the nebulæ can have a spectrum which differs in some respects from that obtained in our laboratories. The difference, if it is real, as I believe it to be, may be a key which will finally unlock some of the many mysteries by which the nature and constitution of the nebulæ are still surrounded.

WOLF'S PERIODICAL COMET.

By W. J. Hussey.

On the night of June 16th, I turned the 36-inch refractor to the place given by Thraen's ephemeris of Wolf's periodical comet (*Astronomische Nachrichten*, No. 3484), and at once found it at less than its own diameter from its predicted place. My observation at the time of rediscovery gives the following position, which is already corrected for parallax and aberration:—

Greenwich M. T.	True α	True δ
1898 June 16.95449	$2^h\ 16^m\ 18^s.68$	$+19^\circ\ 42'\ 46''.3$

For the same epoch, the position which I have obtained by computation from Thraen's elements of the orbit is only $1^s.31$ larger in right ascension and only $1''.1$ smaller in declination. These residuals are remarkably small, and show that Thraen has reached most excellent results in his determination of the definitive elements of the orbit.

This comet was first seen as a nebulous body by Max Wolf at Heidelberg, September 17, 1884, and its cometary nature was fully established by him on September 18th and 19th. He then notified the Strassburg Observatory of his discovery, and the first accurate position of the comet was obtained there on September 20th. On September 22d the comet was discovered independently at the Dun Echt Observatory by Ralph Copeland, who detected it "as a gaseous body with the spectroscope." The telegram announcing the discovery by WOLF was not delivered at the Dun Echt Observatory until the morning of September 23d. It is of interest to note that the first observation of the comet in this country was that obtained at Washington by Commander (now Acting Rear-Admiral) WM. T. SAMPSON, of the U. S. Navy, who was then in charge of the 9.6-inch telescope of the Naval Observatory.

At the first apparition the various observers described the comet as a bright nebulous body, about 2′ in diameter, having a strong central condensation, almost stellar in appearance, and equal in brightness to a star of from the 8th to 11th magnitude. It had scarcely a trace of a tail; many observers did not note any at all, but described the comet as being very nearly round. Spectroscopic observations were made at Nice and Rome. The observations at Nice, towards the end of September, showed a bright continuous spectrum crossed by the three usual carbon bands. At Rome apparently only the middle (and brightest) of these bands was seen.

The comet had been under observation only a short time, when it was found that the observed places could not be satisfactorily represented on the supposition of parabolic motion. Elliptic elements were accordingly computed by KRUEGER, CHANDLER, WENDELL, ZELBR and THRAEN. Their results showed the comet to be one of short period, requiring about 6¾ years to complete a revolution about the sun. It was also noticed that the comet had been so near *Jupiter* from March to August, 1875, as to experience very marked perturbations. LEHMANN-FILHÉS undertook the investigation of the changes in the elements resulting from these perturbations. Basing his work on KRUEGER'S elements, which were admittedly only approximately true, he found that the axis of the orbit had been turned through an angle of nearly 27°, that the inclination had been diminished more than 2°, the eccentricity had been doubled and the periodic time shortened over two years. Moreover, the perihelion distance had been changed from about 309,000,000 to 146,000,000 miles, showing that prior to 1875, the comet had at all times been so distant from the earth as to be either invisible or at least be so faint as to be readily overlooked, thus accounting for its not having been discovered before that time.

These circumstances gave the comet a wide interest among astronomers. It was observed a long time at many observatories.

During the first apparition no less than 950 observations were secured at some fifty-four different observatories, from September 20, 1884, to April 6, 1885. During these six and one-half months the comet described 106 degrees of its heliocentric arc, 35° before and 71° after perihelion passage. Numerous observations were obtained toward the close of the apparition, thus strengthening greatly that part of the arc and giving the final elements greater security. The definitive elements were computed by THRAEN, and both he and L. STRUVE computed the perturbations between the first and second apparitions, and provided ephemerides by means of which SPITALER rediscovered the comet, May 1, 1891.

At the second apparition the comet again remained visible for a long time, until March 31, 1892, and no less than 681 observations at thirty-three different observatories were obtained. THRAEN again computed the definitive elements, making use of the data of both the first and second apparitions and taking into account the perturbations of the Earth, *Mars*, *Jupiter* and *Saturn*. The elements which he finally obtained, when referred to the ecliptic and the mean equinox of 1898.0, are as follows:—

Epoch and Osculation 1898 August 22.0 Berlin M. T.

$$\left.\begin{array}{rl} M = & 6^\circ\ 58'\ 11''.03 \\ \omega = & 172\ \ 52\ \ 35\ .77 \\ \Omega = & 206\ \ 27\ \ 22\ .26 \\ i = & 25\ \ 12\ \ 16\ .59 \\ \phi = & 33\ \ 44\ \ \ 2\ .15 \end{array}\right\}\ \text{Ecliptic and Mean Equinox of 1898.0}$$

$$\mu = 518''.36764$$

$$\log a = 0.5569125$$

The accuracy of these elements is very great, as is shown by the close agreement of the computed and observed places of the comet at the time of its rediscovery this year, and they reflect great credit upon their author.

MT. HAMILTON, July 11, 1898.

COMET *c*, 1898 (CODDINGTON).

By E. F. CODDINGTON.

On the evening of June 9th, I made an exposure of two hours with the Crocker photographic telescope, for the purpose of obtaining a photograph of the extensive nebulous region to the